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SOUTHERN COMPANY
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March 3, 2000

Docket Nos. 50-321
50-366

HL-5902

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Edwin I. Hatch Nuclear Plant
Third Ten Year Interval Inservice Inspection Program
Submittal of Additional Requests for Relief

Ladies and Gentlemen:

This letter is to submit modified Relief Requests (RR-25 and RR-26) for the Third 10-Year Interval Inservice Inspection Program for the Edwin I. Hatch Nuclear Plant. The Relief Requests were originally submitted in a letter dated July 9, 1999, and modified in a letter dated January 11, 2000. The Relief Requests have been further modified to limit the application of the proposed alternate repair techniques, in accordance with ASME Code Cases N-562 and N-561, to the Plant Service Water (PSW) and Residual Heat Removal Service Water (RHRSW) systems, for specific degradation mechanisms. Please disregard the previously submitted Relief Requests, RR-25 and RR-26, and consider the attached version for granting relief.

Should you have any questions in this regard, please contact this office.

Respectfully submitted,

Lewis Sumner

H. L. Sumner, Jr.

IFL/eb

Attachments: Requests for Relief RR-25 and RR-26

cc: (See next page.)

A047

cc: Southern Nuclear Operating Company
Mr. P. H. Wells, Nuclear Plant General Manager
SNC Document Management (R-Type A02.001)

U.S. Nuclear Regulatory Commission, Washington, D.C.
Mr. L. N. Olshan, Project Manager - Hatch

U.S. Nuclear Regulatory Commission, Region II
Mr. L. A. Reyes, Regional Administrator
Mr. J. T. Munday, Senior Resident Inspector - Hatch

Attachment

RELIEF REQUEST

RR-25

SOUTHERN NUCLEAR OPERATING COMPLANY
HATCH NUCLEAR PLANT, UNIT 1 & 2
THIRD 10-YEAR INTERVAL
REQUEST FOR RELIEF NO. RR-25

I. System/Component for Which Relief is Requested: All ASME Class 3 Moderate Energy (i.e., less than or equal to 200°F and less than or equal to 275 psig maximum operating conditions)Carbon Steel Plant Service Water Piping Systems (Categories D-A, D-B, and D-C). Plant Service Water Systems at Plant Hatch are raw river water systems operating at approximately 125 psig at a maximum intake temperature of 95° F and normal operating heat exchanger discharge temperature of 125° F. These operating conditions are well below the two-phase flow parameters normally associated with Flow Accelerated Corrosion (FAC).

II. Code Requirement:

1) ASME Code, Section XI, IWA-4120(a) requires that repairs be performed in accordance with the Owner's Design Specification and or the original Construction Code of the component or system.

2) ASME Code, Section XI, IWA-4320 requires that the defect be removed or reduced in size in accordance with Article IWA.

III. Code Requirement for Which Relief is Requested: Relief is requested from removing defects and repairing in accordance with the design specification or the original construction code for internal under-deposit pitting including microbiological corrosion (MIC).

IV. Basis for Relief: The ASME Section XI Code Committee recognized that an alternative existed for internal wall thinning of Class 3 piping systems which have experienced degradation mechanisms such as MIC that would provide an acceptable repair configuration. The primary purpose for implementing this repair method is to allow for adequate time for additional examination of adjacent piping so that pipe replacement can be planned to reduce impact on system availability including Maintenance Rule applicability, availability of replacement materials and cost. This alternative repair technique involves the application of additional weld metal on the exterior of the piping system which restores the wall thickness requirement. Code Case N-562 was approved by the ASME Section XI Code Committee on December 31, 1996, however, has not been incorporated into NRC Regulatory Guide 1.147 and thus is not available for application at nuclear power plants.

V. Alternate Repair Technique: Plant Hatch will implement the requirements of Code Case N-562 in its entirety with the additional restrictions and exceptions as described below, for Class 3 moderate energy (i.e., $\leq$ 200°F and $\leq$ 275 psig maximum operating pressure) plant service water piping system repairs resulting from under-deposit pitting such as MIC. These type defects are typically identified by small leaks in the piping system or by pre-emptive non-code required examinations performed by the Licensee to monitor the degradation mechanisms. The repair technique described in Code Case N-562 will be utilized whenever engineering evaluation determines that such a repair is suitable for the particular defect or degradation being resolved. Provisions for use of this Code Case will be addressed in the Repair and Replacement Program Procedure. Those provisions will require that adjacent area be examined to verify that the entire flawed area will be encompassed by the repair and that there are no other unacceptable degraded locations within a representative area

dependent on the degradation mechanism present. An evaluation of the degradation mechanism will be performed to determine the re-examination schedule to be performed over the life of the repair. The repair will be considered to have a maximum service life of two fuel cycles unless specific approval is requested and received from the NRC to make it permanent.

Southern Nuclear Operating Company (SNC) previously submitted ISI Relief Request RR-14 which requested approval to utilize ASME Section XI Code Case N-532. Code Case N-532 provides alternatives for the documentation requirements for repair and replacement activities. Code Case N-532 allows use of Form NIS-2A in lieu of Form NIS-2 as required by Code Case N-562, paragraph 7.0. Therefore, SNC will document the use of Code Case N-562 on Form NIS-2A in lieu of Form NIS-2, as previously approved by the NRC by granting Relief Request RR-14.

VI. Justification for Granting Relief: Code Case N-562 provides alternative requirements to those of IWA-4000 and for the repair of internal piping system defects or degradation. The ASME XI Code Committee determined that such a repair technique would ensure that an adequate level of quality and safety was being maintained. Therefore, the proposed alternative is justified per 10CFR50.55a(3)(i). Code Case N-562 has not been included in NRC Regulatory Guide 1.147 and therefore, SNC is documenting the request to apply the Code Case via this relief request. A copy of ASME Section XI Code Case N-562 is attached for reference.

VII. Implementation Schedule: The relief request is applicable for the Third 10-Year Interval and will be utilized upon receipt of NRC approval.

VIII. Relief Request Status: Submitted to NRC for review and approval.

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Approval Date: December 31, 1996
See Numeric Index for expiration and any reaffirmation dates.

Case N-562
Alternative Requirements for Wall Thickness Restoration of Class 3 Moderate Energy Carbon Steel Piping
Section XI, Division 1

Inquiry: As an alternative to replacement or internal weld repair, what requirements may be applied for wall thickness restoration of Class 3 moderate-energy carbon steel piping systems that have experienced internal wall thinning or pitting from conditions such as, but not limited to, flow-assisted corrosion and microbiological corrosion?

Reply: It is the opinion of the Committee that areas of Class 3 moderate energy (i.e., less than or equal to 200°F or and less than or equal to 275 psig maximum operating conditions) carbon steel piping experiencing internal thinning or pitting may have the wall thickness restored externally by means of a weld-deposited carbon or low-alloy steel reinforcement on the outside surface of the piping in accordance with the following requirements. Excluded from these provisions are conditions involving corrosion-assisted cracking or any other form of cracking.

1.0 GENERAL REQUIREMENTS

(a) The wall thickness restoration shall be performed in accordance with a Repair/Replacement Plan [Repair Program][1] satisfying the requirements of IWA-4140 [IWA-4130].

(b) The wall thickness restoration shall meet the requirements of IWA-4000 [IWA-4000/7000 and IWD-4000/7000 as applicable], except as stated in this Case.

(c) If the minimum required thickness of deposited weld metal necessary to satisfy the requirements of para. 3.0 is greater than the nominal thickness for the size and schedule of the piping, the provisions of this Case shall not apply. In addition, the total thickness of filler metal applied over multiple repairs shall not exceed the original nominal thickness of the piping.

2.0 INITIAL EVALUATION

The material beneath the surface to which the weld overlay is to be applied shall be evaluated to establish the existing average wall thickness and the extent and configuration of degradation to be reinforced by the weld overlay. Consideration shall be given to the cause of degradation. The extent of degradation in the piping, and the impact of the repair on the piping, shall be evaluated in accordance with IWA-4160 [IWA-4150].

3.0 DESIGN

3.1 General Design Requirements

(a) Unless otherwise established by theoretical or experimental analysis, or by proof testing as provided for in para. 3.3 or para. 3.4, the full thickness of the weld overlay shall extend a distance of at least s_{min} in each direction beyond the area predicted, over the design life of the restoration to infringe upon the required thickness.[2]

where

$s_{min} = \frac{3}{4}\sqrt{Rt_{nom}}$

R = outer radius of the component

t_{nom} = nominal wall thickness of the component

Edges of the weld overlay shall be tapered to the existing piping surface at a maximum angle ("α" in Fig. 1) of 45 deg. Final configuration of the reinforcement shall permit the examinations and evaluations required herein, including any required preservice or inservice examinations of encompassed or adjacent welds.

[1] When applying this Case to the 1989 Edition with the 1990 Addenda, or earlier Editions and Addenda, the references contained in brackets shall apply.

[2] Design thickness as prescribed by the Construction Code.

(b) The thickness shall be sufficient to maintain required thickness for the predicted life of the repair, and, except for the tapered edges, the overlay shall have a uniform thickness.

(c) The tensile strength of the weld filler metal for the reinforcement shall be at least that specified for the base metal to which it is applied.

(d) The predicted maximum degradation of the overlaid piping and the overlay over the design life of the restoration shall be considered in the design. The predicted degradation of the piping shall be based upon in-situ inspection and established data for similar base metals. If the weld overlay is predicted to become exposed to the corroding medium, the predicted degradation of the overlay shall be based upon established data for base metals or weld metals with similar chemical composition to that of the filler metal used for the weld overlay.

(e) The effect of weld overlay application on interior coating shall be addressed in the design or installation procedure.

3.2 Design

The design of weld overlays not prequalified by paras. 3.3, 3.4, or 3.5 shall be in accordance with the applicable requirements of the Construction Code or ND-3100 and ND-3600 (including Appendix II), and shall consider the weld overlay as an integral portion of the piping or component upon which it is applied (not as a weld). The allowable stress values of the base metal shall apply to the design of the deposited weld metal. The following factors shall be considered, as applicable, in the design and application of the reinforcement:

(a) The shrinkage effects, if any, on the piping.

(b) Stress concentrations caused by application of the overlay or resulting from existing and predicted piping internal surface configuration.

3.3 Proof Test Qualification as a Piping Product

As an alternative to design, the configuration of weld overlays may be qualified by performance of proof testing of a mock-up in accordance with the following requirements:

(a) A satisfactory mock-up burst test shall qualify the design or configuration for application in the same orientation on the same type of item, and the same location on fittings, when the following conditions are satisfied (see Fig. 1):

(1) the base metal is of the same P-No. and Group Number when impact properties are applicable, as the base metal tested;

(2) the specified minimum tensile strength of the item does not exceed that specified for the base metal tested;

(3) the average thickness of the overlay areas is at least the thickness of the mock-up plug, u;

(4) the overlap on the full thickness of base metal, s, is at least that of the mock-up;

(5) the transition angle at the outer edges of the overlay, α, is not greater than that of the mock-up;

(6) the overlay surface finish is similar to or smoother than that tested;

(7) the maximum proportionate axial dimension, L/D, is not more than that tested;

(8) the maximum proportionate circumferential dimension, C/D, is not more than that tested;

(9) the nominal diameter is not less than one-half nor more than two times the diameter tested;

(10) the nominal thickness/diameter ratio, t/D, is not less than one-half nor more than three times the t/D, ratio tested.

(b) The mock-up base shall consist of new base material of similar configuration, or type of item, as the item to be overlaid. A rounded-corner segment of the base material shall be removed to represent the maximum proportionate size (axial dimension of L and circumferential dimension of C) and location of thinning or pitting to be compensated for by the weld overlay. A plug of the same base metal and of uniform thickness u, which shall not exceed the smallest average thickness on which the overlays will be permanently applied, shall be full-penetration welded around the opening and flush with the outside surface of the piping. Alternatively, an equivalent volume of base metal may be removed from the inside surface of the mock-up by machining or grinding, without need for welding in a closure plug.

(c) The mock-up weld overlay shall be applied in accordance with the design or specified configuration using the specified weld filler metal. Maximum section thickness at the overlaid opening (weld metal plus base metal plug, $u + w$) shall not exceed 87½% of the nominal thickness of the piping.

(d) Straight pipe equivalent to a minimum of one pipe diameter, or one-half diameter for piping over NPS 14, shall be provided (butt-welded to the mock-up, if necessary) beyond both ends of the overlay. The piping shall be capped and the completed mock-up assembly shall be thoroughly vented and hydrostatically

pressure tested to bursting. To qualify the design for general application (within the limits of para. 3.3(a)), burst pressure shall not be less than:

$$P = \frac{2tS_{act}}{D_o}$$

where

P = minimum acceptable burst pressure, psi
t = minimum specified thickness (excluding manufacturing tolerance) of the base metal being tested, in.
S_{act} = reported actual tensile strength of the base metal being tested, psi
D_o = outside diameter of the pipe, in.

(e) If flexibility analysis was required by the original Construction Code, the effect of the weld overlay shall be reconciled with the original analysis. In this case, for rectangular-shaped overlays on straight pipe designed to ND-3650 and aligned parallel or perpendicular to the axis of the pipe, a Stress Intensification Factor (SIF) of 2.1 shall be applied unless a lower SIF is established.

3.4 Proof Test Qualification for Specific Applications

As an alternative to design by analysis or proof test qualification as a piping product, the design or configuration of weld overlays may be qualified for limited service conditions using the provisions of ND-6900. "Proof Tests to Establish Design Pressure," except that component hydrostatic testing is not required (other than as required by IWA-4000). The mock-ups shall be fabricated and tested in accordance with the provisions of para. 3.3(b), (c), and (d), and shall be applied in accordance with the provisions and conditions of para. 3.3(a). The provisions of para. 3.3(e) shall be met.

3.5 Prequalified Design

Application of weld overlays on straight pipe and associated welds to correct limited degradation shall be exempt from the requirements of para. 3.2 through para. 3.4, provided all of the following conditions are satisfied:

(a) All of the requirements of para. 3.1 apply.

(b) The provisions of para. 3.3(e) shall be met.

(c) The full thickness of weld overlay shall not exceed a maximum axial length of the greater of six in. or the outside diameter of the piping.

(d) The finished overlay shall be circular, oval, full-circumferential, or rectangular in shape.

(1) For each repair, the maximum dimension compensated by a circular overlay shall not exceed $^2/_3$ the nominal outside diameter of the piping.

(2) Rectangular overlays shall be aligned parallel with or perpendicular to the axis of the piping, and corners shall be rounded with radii not less than the overlay thickness.

(3) For oval overlays, the end radii shall not be less than $^3/_4\sqrt{Ri_{nom}}$, and the axis of the overlay shall be aligned parallel with or perpendicular to the axis of the piping.

(e) The distance between toes of adjacent overlays shall not be less than t_{nom}.

4.0 Water-backed Applications

(a) Manual application of overlays on water-backed piping shall be restricted to P-No. 1 base materials. Welding of such overlays shall use the SMAW process and low-hydrogen electrodes. In addition, the surface examination required in para. 6.0 shall be performed no sooner than 48 hours after completion of welding. For such overlays consideration should be given to using a temper bead technique similar to that described in IWA-4540.

(b) Piping with wall thickness less than the diameter of the electrode shall be depressurized before welding.

5.0 INSTALLATION

(a) The entire surface area to which the weld overlay is to be applied shall be examined using the liquid penetrant or magnetic particle method, with acceptance criteria in accordance with ND-2500/5300 for the product form (base metal or weld) involved.

(b) If through-wall repairs are required to satisfy the acceptance criteria, or result from application of the weld overlay, they shall be accomplished by sealing with weld metal using a qualified weld procedure suitable for open-root welding. This weld shall be examined in accordance with para. 5.0(a). In addition, the first layer of overlay over the repaired area shall be examined in accordance with para. 5.0(a).

(c) Overlay weld metal shall be deposited using a grove-welding procedure qualified in accordance with Section IX, and the Construction Code or Section III, or IWA-4500, IWA-4510, or IWA-4540. The qualified minimum thickness specified in the weld procedure

does not apply to the weld overlay or associated base metal repairs.[3]

(d) The surface of the weld overlay shall be prepared by machining or grinding, as necessary, to permit performance of surface and volumetric examinations required by para. 6.0. For ultrasonic examination, a surface finish of 250 RMS or better is required.

6.0 EXAMINATION

(a) The completed weld overlay shall be examined using the liquid penetrant or magnetic particle method and shall satisfy the surface examination acceptance criteria for welds of the Construction Code or ND-5300.

(b) The weld overlay, including the existing piping upon which it is applied, shall be examined to verify acceptable wall thickness.

(c) Weld overlays shall be volumetrically examined as base metal repairs when required by the Construction Code, except as follows:

(1) Weld overlays not exceeding 10 sq. in. surface area are exempt from volumetric examination.

(2) Other weld overlays shall be exempt from volumetric examination when the finished applied thickness (*w*, in Fig. 1) does not exceed

(a) $\frac{1}{3}t$ for $t \leq \frac{3}{4}$ in.

(b) $\frac{1}{4}$ in. for $\frac{3}{4}$ in. $< t \leq 2\frac{1}{2}$ in.

(c) The lesser of $\frac{3}{8}$" or 10% of t for $t > 2\frac{1}{2}$ in.

where

t = finished full-section thickness of compensated area (e.g., "$w + u$," in Fig. 1)

When volumetric examination is required, the full volume of the finished overlay, excluding the tapered edges, but including the volume of base metal required for the design life of the overlay, shall be examined by either the ultrasonic or radiographic method, and shall, to the depth at the surface of the existing piping, satisfy the acceptance criteria for welds of the Construction Code or ND-5300. The volume of the existing piping, beneath the weld overlay, taken credit for in the design, shall satisfy the volumetric acceptance criteria of ND-2500/5300 for the product form, or IWA-3000 [and IWB-3514].

(d) Follow-up inspection shall be scheduled as necessary to confirm any design assumptions relative to rate or extent of future degradation.

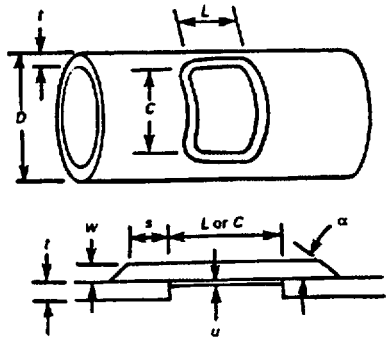

FIG. 1

7.0 DOCUMENTATION

Use of this Case shall be documented on an NIS-2 Form.

[3] Exception to IWA-4000.

Attachment

RELIEF REQUEST

RR-26

SOUTHERN NUCLEAR OPERATING COMPLANY
HATCH NUCLEAR PLANT, UNIT 1 & 2
THIRD 10-YEAR INTERVAL
REQUEST FOR RELIEF NO. RR-26

I. System/Component for Which Relief is Requested: All ASME Class 2 RHR Service Water, Class 2 Plant Service Water, and High Energy (i.e., greater than 200°F or greater than 275 psig maximum operating conditions) Class 3 RHR Service Water Carbon Steel Piping Systems (Categories C-F-2, C-H, D-A, D-B, and D-C). Plant Service Water Systems at Plant Hatch are raw river water systems operating at approximately 125 psig at a maximum intake temperature of 95° F and normal operating heat exchanger discharge temperature of 125° F. RHR Service Water Systems are raw river water systems operating at approximately 428 psig at a maximum intake temperature of 95° F and normal operating heat exchanger discharge temperature of 125° F. These operating conditions are well below the two phase flow parameters normally associated with Flow Accelerated Corrosion (FAC).

II. Code Requirement:

1. ASME Code, Section XI, IWA-4120(a) requires that repairs be performed in accordance with the Owner's Design Specification and or the original Construction Code of the component or system.

2. ASME Code, Section XI, IWA-4320 requires that the defect be removed or reduced in size in accordance with Article IWA.

III. Code Requirement for Which Relief is Requested: Relief is requested from removing defects and repairing in accordance with the design specification or the original construction code for internal under-deposit pitting including microbiological corrosion (MIC).

IV. Basis for Relief: The ASME Section XI Code Committee recognized that an alternative existed for internal wall thinning of Class 2 and 3 piping systems which have experienced degradation mechanisms such as MIC that would provide an acceptable repair configuration. The primary purpose for implementing this repair method is to allow for adequate time for additional examination of adjacent piping so that pipe replacement can be planned to reduce impact on system availability including Maintenance Rule applicability, availability of replacement materials and cost. This alternative repair technique involves the application of additional weld metal on the exterior of the piping system which restores the wall thickness requirement. Code Case N-561 was approved by the ASME Section XI Code Committee on December 31, 1996, however, it has not been incorporated into NRC Regulatory Guide 1.147 and is thus not available for application at nuclear power plants.

V. Alternate Repair Technique: Plant Hatch will implement the requirements of Code Case N-561 in its entirety with the additional restrictions and exceptions as described below, for Class 2 and high energy Class 3 piping system repairs resulting from under-deposit pitting such as MIC. These type defects are typically identified by small leaks in the piping system or by pre-emptive non-code required examinations performed by the Licensee to monitor the degradation mechanisms. The repair technique described in Code Case N-561 will be utilized whenever engineering evaluation determines that such a repair is suitable for the particular defect or degradation being resolved. Provisions for use of this Code Case will be addressed in the Repair and Replacement Program Procedure. Those provisions will require that adjacent area be examined to verify that the entire flawed area will be encompassed by the repair and that there are no other unacceptable degraded locations within a representative area

dependent on the degradation mechanism present. An evaluation of the degradation mechanism will be performed to determine the re-examination schedule to be performed over the life of the repair. The repair will be considered to have a maximum service life of two fuel cycles unless specific approval is requested and received from the NRC to make it permanent.

Southern Nuclear Operating Company (SNC) previously submitted ISI Relief Request RR-14 which requested approval to utilize ASME Section XI Code Case N-532. Code Case N-532 provides alternatives for the documentation requirements for repair and replacement activities. Code Case N-532 allows use of Form NIS-2A in lieu of Form NIS-2 as required by Code Case N-561, paragraph 7.0. Therefore, SNC will document the use of Code Case N-561 on Form NIS-2A in lieu of Form NIS-2 as previously approved by the NRC by granting Relief Request RR-14.

VI. Justification for Granting Relief: Code Case N-561 provides alternative requirements to those of IWA-4000 and for the repair of internal piping system defects or degradation. The ASME XI Code Committee determined that such a repair technique would ensure that an adequate level of quality and safety was being maintained. Therefore, the proposed alternative is justified per 10CFR50.55a(3)(i). Code Case N-561 has not been included in NRC Regulatory Guide 1.147 and therefore, SNC is documenting the request to apply the Code Case via this relief request. A copy of ASME Section XI Code Case N-561 is attached for reference.

VII. Implementation Schedule: The relief request is applicable for the Third 10-Year Interval and will be utilized upon receipt of NRC approval.

VIII. Relief Request Status: Submitted to NRC for review and approval.

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Approval Date: December 31, 1996
See Numeric Index for expiration and any reaffirmation dates.

Case N-561
Alternative Requirements for Wall Thickness Restoration of Class 2 and High Energy Class 3 Carbon Steel Piping
Section XI, Division 1

Inquiry: As an alternative to replacement or internal weld repair, what requirements may be applied for wall thickness restoration of Class 2 and high-energy Class 3 carbon steel piping systems that have experienced internal wall thinning or pitting from conditions such as, but not limited to, flow-assisted corrosion and microbiological corrosion?

Reply: It is the opinion of the Committee that areas of Class 2 and high-energy (i.e., greater than 200°F or 275 psig maximum operating conditions) Class 3 carbon steel piping experiencing internal thinning or pitting may have the wall thickness restored externally by means of a weld-deposited carbon or low-alloy steel reinforcement on the outside surface of the piping in accordance with the following requirements. Excluded from these provisions are conditions involving corrosion-assisted cracking or any other form of cracking.

1.0 GENERAL REQUIREMENTS

(a) The wall thickness restoration shall be performed in accordance with a Repair/Replacement Plan [Repair Program][1] satisfying the requirements of IWA-4140 [IWA-4130].

(b) The wall thickness restoration shall meet the requirements of IWA-4000 [IWA-4000, IWA-7000 and IWC-4000, IWD-4000, IWC-7000, IWD-7000, as applicable], except as stated in this Case.

(c) If the minimum required thickness of deposited weld metal necessary to satisfy the requirements of para. 3.0 is greater than the nominal thickness for the size and schedule of the piping, the provisions of this Case shall not apply. In addition, the total thickness of filler metal applied over multiple repairs shall not exceed the original nominal thickness of the piping.

2.0 INITIAL EVALUATION

The material beneath the surface to which the weld overlay is to be applied shall be evaluated to establish the existing average wall thickness and the extent and configuration of degradation to be reinforced by the weld overlay. Consideration shall be given to the cause of degradation. The extent of degradation in the piping, and the impact of the repair on the piping, shall be evaluated in accordance with IWA-4160 [IWA-4150].

3.0 DESIGN

3.1 General Design Requirements

(a) Unless otherwise established by theoretical or experimental analysis, or by proof testing as provided for in para. 3.3 or para. 3.4, the full thickness of the weld overlay shall extend a distance of at least s_{min} in each direction beyond the area predicted, over the design life of the restoration to infringe upon the required thickness.[2]

where

$s_{min} = \frac{3}{4}\sqrt{Rt_{nom}}$

R = outer radius of the component

t_{nom} = nominal wall thickness of the component

Edges of the weld overlay shall be tapered to the existing piping surface at a maximum angle ("α" in Fig. 1) of 45 deg. Final configuration of the reinforcement shall permit the examinations and evaluations required herein, including any required preservice or inservice examinations of encompassed or adjacent welds.

(b) The thickness shall be sufficient to maintain required thickness for the predicted life of the repair, and, except for the tapered edges, the overlay shall have a uniform thickness.

(c) The tensile strength of the weld filler metal used for reinforcement shall be at least that specified for the base metal to which it is applied.

[1] When applying this Case to the 1989 Edition with the 1990 Addenda, or earlier Editions and Addenda, the references contained in brackets shall apply.

[2] Design thickness as prescribed by the Construction Code.

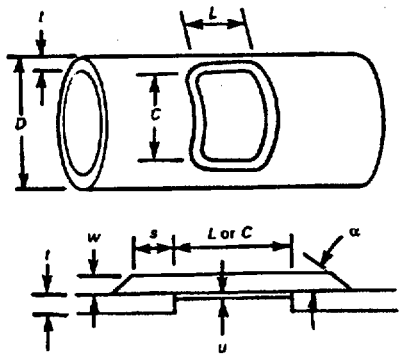

FIG. 1

(d) The predicted maximum degradation of the overlaid piping and the overlay over the design life of the restoration shall be considered in the design. The predicted degradation of the piping shall be based upon in-situ inspection and established data for similar base metals. If the weld overlay is predicted to become exposed to the corroding medium, the predicted degradation of the overlay shall be based upon established data for base metals or weld metals with similar chemical composition to that of the filler metal used for the weld overlay.

3.2 Design

The design of weld overlays not prequalified by para. 3.3, para. 3.4, or para. 3.5 shall be in accordance with the applicable requirements of the Construction Code or NC/ND-3100 and NE/ND-3600 (including Appendix II), and shall consider the weld overlay as an integral portion of the piping or component upon which it is applied (not as a weld). The allowable stress values of the base metal shall apply to the design of the deposited weld metal. The following factors shall be considered in the design of the reinforcement:

(a) The effects on the piping system of radial and longitudinal shrinkage caused by application of the overlay;

(b) The effects on flexibility, stress concentration, and section properties of the added section thickness;

(c) Stress concentrations resulting from existing and predicted piping internal surface configuration;

(d) The effects of different coefficients of thermal expansion between the weld overlay filler metal and the base metal.

3.3 Proof Test Qualification as a Piping Product

As an alternative to design, the configuration of weld overlays may be qualified by performance of proof testing of a mock-up in accordance with the following requirements:

(a) A satisfactory mock-up burst test shall qualify the design or configuration for application in the same orientation on the same type of item, and the same location on fittings, when the following conditions are satisfied (see Fig. 1):

(1) The base metal is of the same P-No. and Group Number when impact properties are applicable, as the base metal tested.

(2) The specified minimum tensile strength of the item does not exceed that specified for the base metal tested.

(3) The average thickness of the overlay areas is at least the thickness of the mock-up plug, u.

(4) The overlap on the full thickness of base metal, s, is at least that of the mock-up.

(5) The transition angle at the outer edges of the overlay, α, is not greater than that of the mock-up.

(6) The overlay surface finish is similar to or smoother than that tested.

(7) The maximum proportionate axial dimension, L/D, is not more than that tested.

(8) The maximum proportionate circumferential dimension, C/D, is not more than that tested.

(9) The nominal diameter is not less than one-half nor more than two times the diameter tested.

(10) The nominal thickness/diameter ratio, t/D, is not less than one-half nor more than three times the t/D, ratio tested.

(b) The mock-up base shall consist of new base material of similar configuration, or type of item, as the item to be overlaid. A rounded-corner segment of the base material shall be removed to represent the maximum proportionate size (axial dimension of L and circumferential dimension of C) and location of thinning or pitting to be compensated for by the weld overlay. A plug of the same base metal and of uniform thickness u, which shall not exceed the smallest average thickness on which the overlays will be permanently applied, shall be full-penetration welded around the opening and flush with the outside surface of the piping. Alternatively, an equivalent volume of base metal may be removed from the inside surface of the mock-up by

machining or grinding, without need for welding in a closure plug.

(c) The mock-up weld overlay shall be applied in accordance with the design or specified configuration using the specified weld filler metal. Maximum section thickness at the overlaid opening (weld metal plus base metal plug, $u + w$) shall not exceed 87½% of the nominal thickness of the piping.

(d) Straight pipe equivalent to a minimum of one pipe diameter, or one-half diameter for piping over NPS 14, shall be provided (butt-welded to the mock-up, if necessary) beyond both ends of the overlay. The piping shall be capped and the completed mock-up assembly shall be thoroughly vented and hydrostatically pressure tested to bursting. To qualify the design for general application (within the limits of para. 3.3(a)), burst pressure shall not be less than

$$P = \frac{2tS_{act}}{D_o}$$

where

P = minimum acceptable burst pressure, psi
t = minimum specified thickness (excluding manufacturing tolerances) of the base metal being tested, in
S_{act} = reported actual tensile strength of the base metal being tested, psi
D_o = outside diameter of the pipe, in.

(e) If flexibility analysis was required by the original Construction Code, the effect of the weld overlay shall be reconciled with the original analysis. In this case, for rectangular-shaped overlays on straight pipe designed to NC/ND-3650 and aligned parallel or perpendicular to the axis of the pipe, a Stress Intensification Factor (SIF) of 2.1 shall be applied unless a lower SIF is established.

3.4 Proof Test Qualification for Specific Applications

As an alternative to design by analysis or proof test qualification as a piping product, the design or configuration of weld overlays may be qualified for limited service conditions using the provisions of NC/ND-6900, "Proof Tests to Establish Design Pressure," except that component hydrostatic testing is not required (other than as required by IWA-4000). The mock-ups shall be fabricated and tested in accordance with the provisions of para. 3.3(b), (c), and (d), and shall be applied in accordance with the provisions and conditions of para. 3.3(a). The provisions of para. 3.3(e) shall be met.

3.5 Prequalified Design

Application of weld overlays on straight pipe and associated welds to correct limited degradation shall be exempt from the requirements of paras. 3.2 through 3.4 provided all of the following conditions are satisfied:

(a) The pipe material has allowable stress, S_m of at least 15,000 psi.

(b) The maximum design temperature does not exceed 650°F.

(c) The specified thickness of the existing base metal shall be at least Schedule 40 or Standard Wall, whichever is less.

(d) The requirements of para. 3.1 apply, except the maximum angle of taper shall not exceed 30 degrees.

(e) The finished overlay shall be circular, oval, full-circumferential or rectangular in shape.

(1) For each repair, the maximum dimension compensated by a circular or oval overlay shall not exceed the lesser of ½ the nominal outside diameter of the piping or 8 in.

(2) Rectangular overlays shall be aligned parallel with or perpendicular to the axis of the piping, and corners shall be rounded with radii not less than the overlay thickness.

(f) The distance between toes of adjacent overlays shall not be less than $\frac{3}{4}\sqrt{Rt_{nom}}$.

(g) The maximum axial dimension and area of base metal predicted to be below the required thickness shall not exceed that defined by

$$L_{max} = k_1 D_o + k_2$$
$$A_{max} = 0.455 D_o - k_3$$

where

L_{max} = maximum axial dimension of base metal predicted to degrade below the required thickness over the remaining life of the repair, in.
A_{max} = maximum area of base metal predicted to degrade below the required thickness over the remaining life of the repair, in.^{2}
D_o = piping nominal outside diameter, in.
k_1 = 0.21 for pipe smaller than NPS 12
= 0.11 for pipe NPS 12 to NPS 24
k_2 = 0.55 in. for pipe smaller than NPS 12
= 1.84 in. for pipe NPS 12 to NPS 24
k_3 = 0.9 in.^{2} for pipe smaller than NPS 8
= 0.8 in.^{2} for pipe NPS 8 to NPS 24

(h) If flexibility analysis was required by the original Construction Code, the effect of the weld overlay shall

be reconciled with the original analysis. In this case, for rectangular-shaped overlays on straight pipe, a Stress Intensification Factor (SIF) of 2.1 shall be applied for the overlay.

4.0 Steam- or Water-Backed Applications

(a) For overlays applied with water backing, the qualification, application, examination and repair requirements of the temper bead welding technique described in IWA-4540 shall apply, except that all references to Subsection NE and Class MC shall be taken as Subsection NC and ND and Class 2 or 3, as applicable.

(b) Piping with wall thickness less than the diameter of the electrode shall be depressurized before welding.

(c) Steam systems shall be depressurized before welding.

5.0 INSTALLATION

(a) The entire surface area to which the weld overlay is to be applied shall be examined using the liquid penetrant or magnetic particle method, with acceptance criteria in accordance with NC/ND-2500/5300 for the product form (base metal or weld) involved.

(b) If through-wall repairs are required to satisfy the acceptance criteria, or result from application of the weld overlay, they shall be accomplished by sealing with weld metal using a qualified weld procedure suitable for open-root welding. This weld shall be examined in accordance with para. 5.0(a). In addition, the first layer of overlay over the repaired area shall be examined in accordance with para. 5.0(a).

(c) Overlay weld metal shall be deposited using a grove-welding procedure qualified in accordance with Section IX, and the Construction Code or Section III, or IWA-4500, IWA-4510, or IWA-4540. The qualified minimum thickness specified in the weld procedure does not apply to the weld overlay or associated base metal repairs.[3]

(d) The surface of the weld overlay shall be prepared by machining or grinding, as necessary, to permit performance of surface and volumetric examinations required by para. 6.0 and any subsequent preservice or inservice examinations. For ultrasonic examination, a surface finish of 250 RMS or better is required.

6.0 EXAMINATION

(a) The completed weld overlay shall be examined using the liquid penetrant or magnetic particle method and shall satisfy the surface examination acceptance criteria for welds of the Construction Code or NC/ND-5300.

(b) The weld overlay, including the existing piping upon which it is applied, shall be examined to verify acceptable wall thickness.

(c) Weld overlays shall be volumetrically examined as base metal repairs when required by the Construction Code, except as follows:

(1) Class 3 weld overlays not exceeding 10 sq. in. surface area are exempt from volumetric examination.

(2) Other weld overlays shall be exempt from volumetric examination when the finished applied thickness (w. in Fig. 1) does not exceed.

(a) $\frac{1}{3}t$ for $t \leq \frac{3}{4}$ in.

(b) $\frac{1}{4}$ in. for $\frac{3}{4}$ in. $< t \leq 2\frac{1}{2}$ in.

(c) The lesser of $\frac{3}{8}$" or 10% of t for $t > 2\frac{1}{2}$ in.

where

t = finished full-section thickness of compensated area (e.g., "$w + u$," in Fig. 1)

When volumetric examination is required, the full volume of the finished overlay, excluding the tapered edges, but including the volume of base metal required for the design life of the overlay, shall be examined by either the ultrasonic or radiographic method, and shall, to the depth at the surface of the existing piping, satisfy the acceptance criteria for welds of the Construction Code or NC/ND-5300. The volume of the existing piping, beneath the weld overlay, taken credit for in the design, shall satisfy the volumetric acceptance criteria of NC/ND-2500/5300 for the product form, or IWA-3000 [and IWB-3514].

(d) Follow-up inspection shall be scheduled as necessary to confirm any design assumptions relative to rate or extent of future degradation.

7.0 DOCUMENTATION

Use of this Case shall be documented on an NIS-2 Form.

[3] Exception to IWA-4000.